CENTERLINE SLOT IMPLEMENTATION

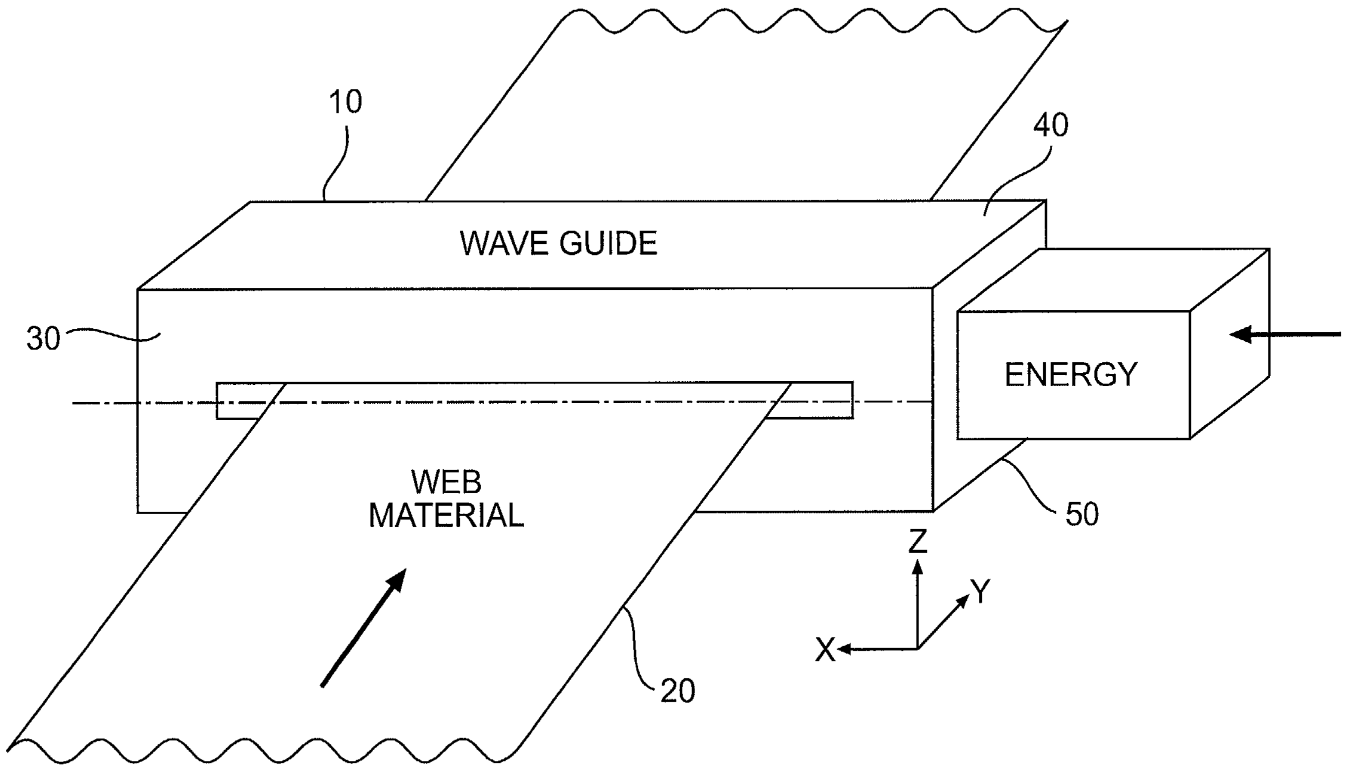


FIG. 1
PRIOR ART

NON-CENTERLINE SLOT

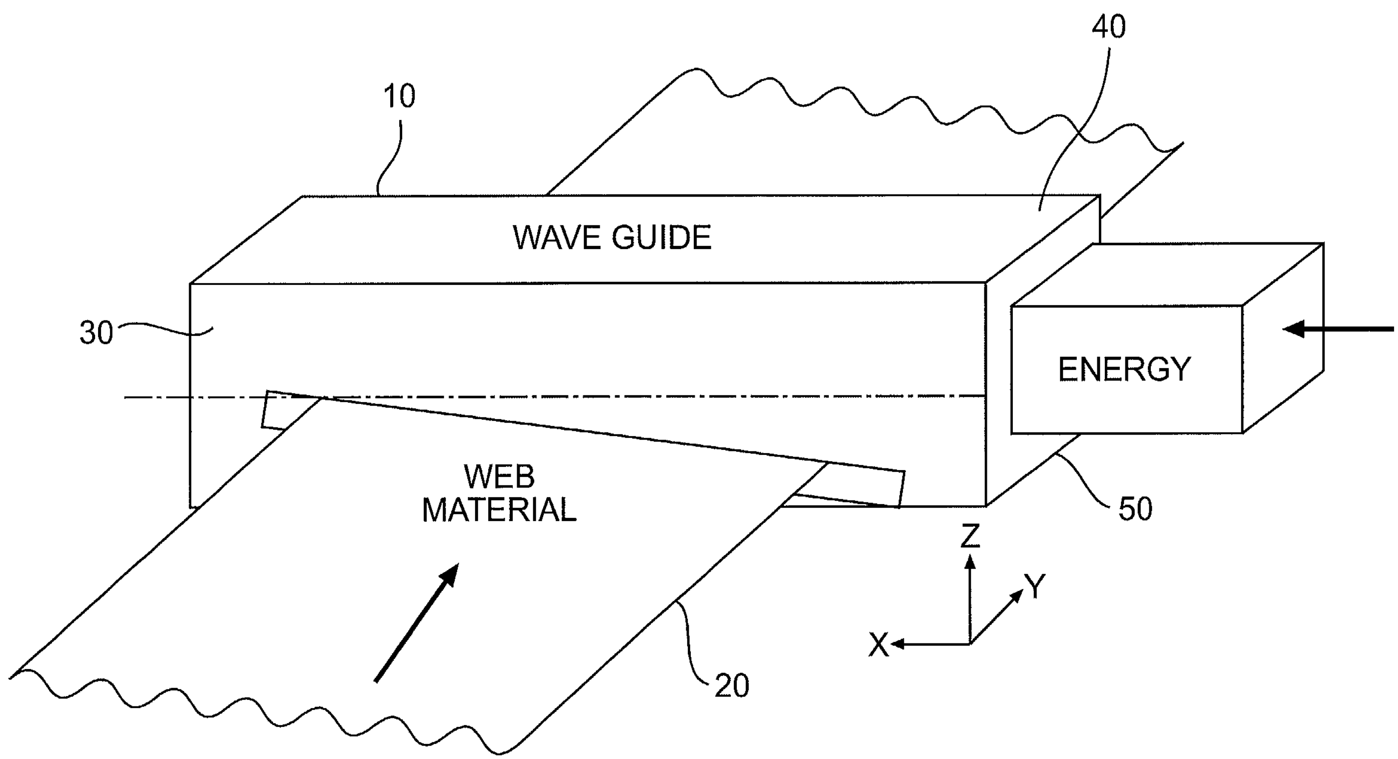
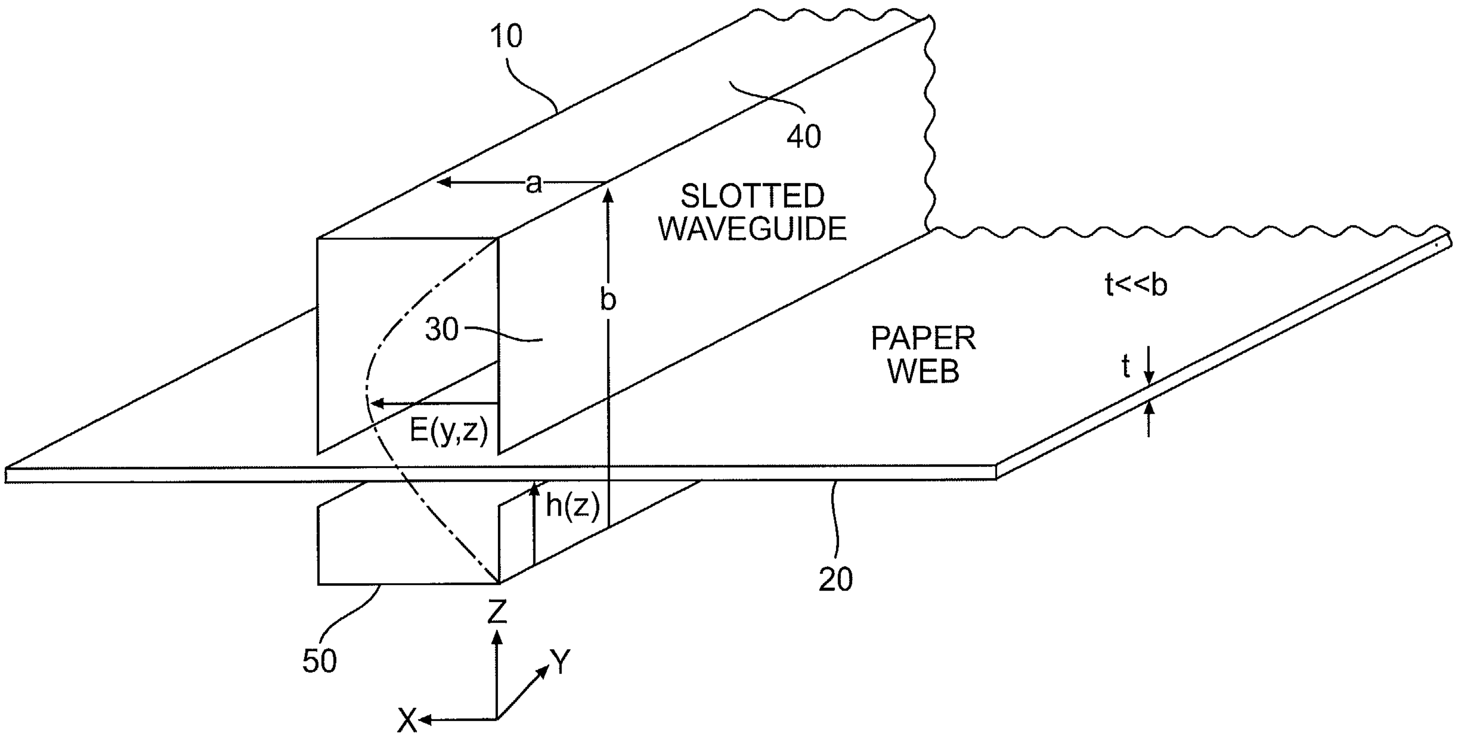
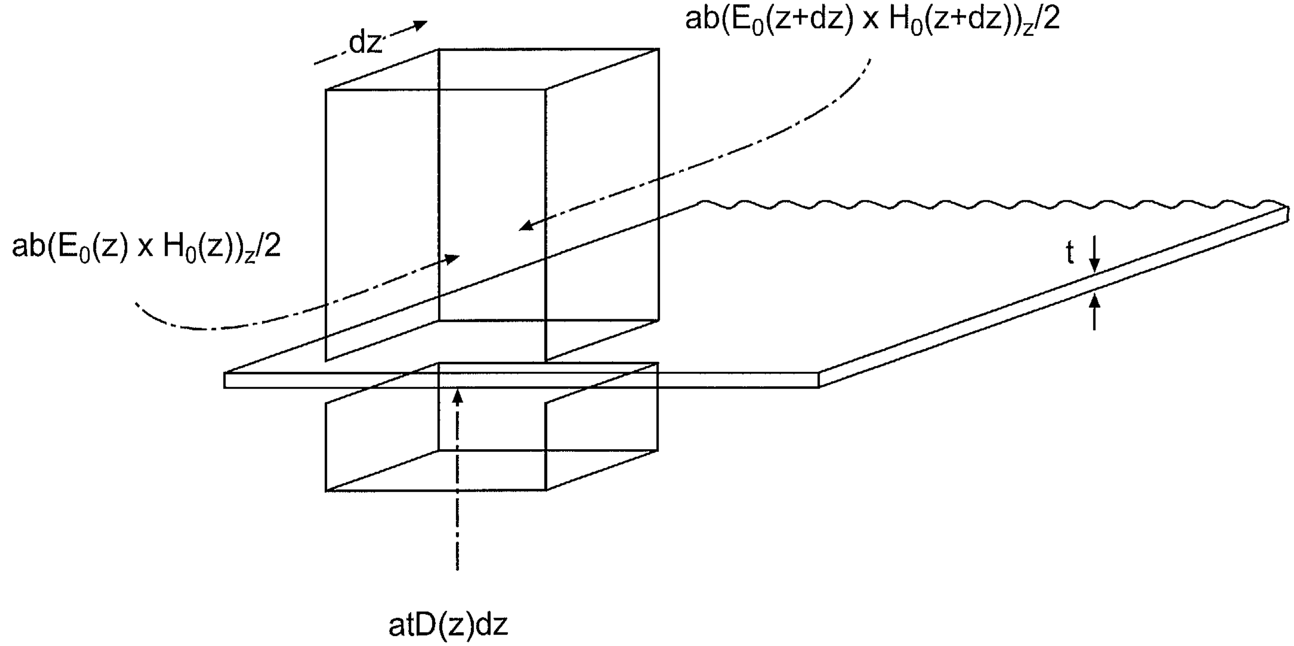


FIG. 2
PRIOR ART



PARAMETERS FOR PAPER DRYING IN A WAVEGUIDE

FIG. 3

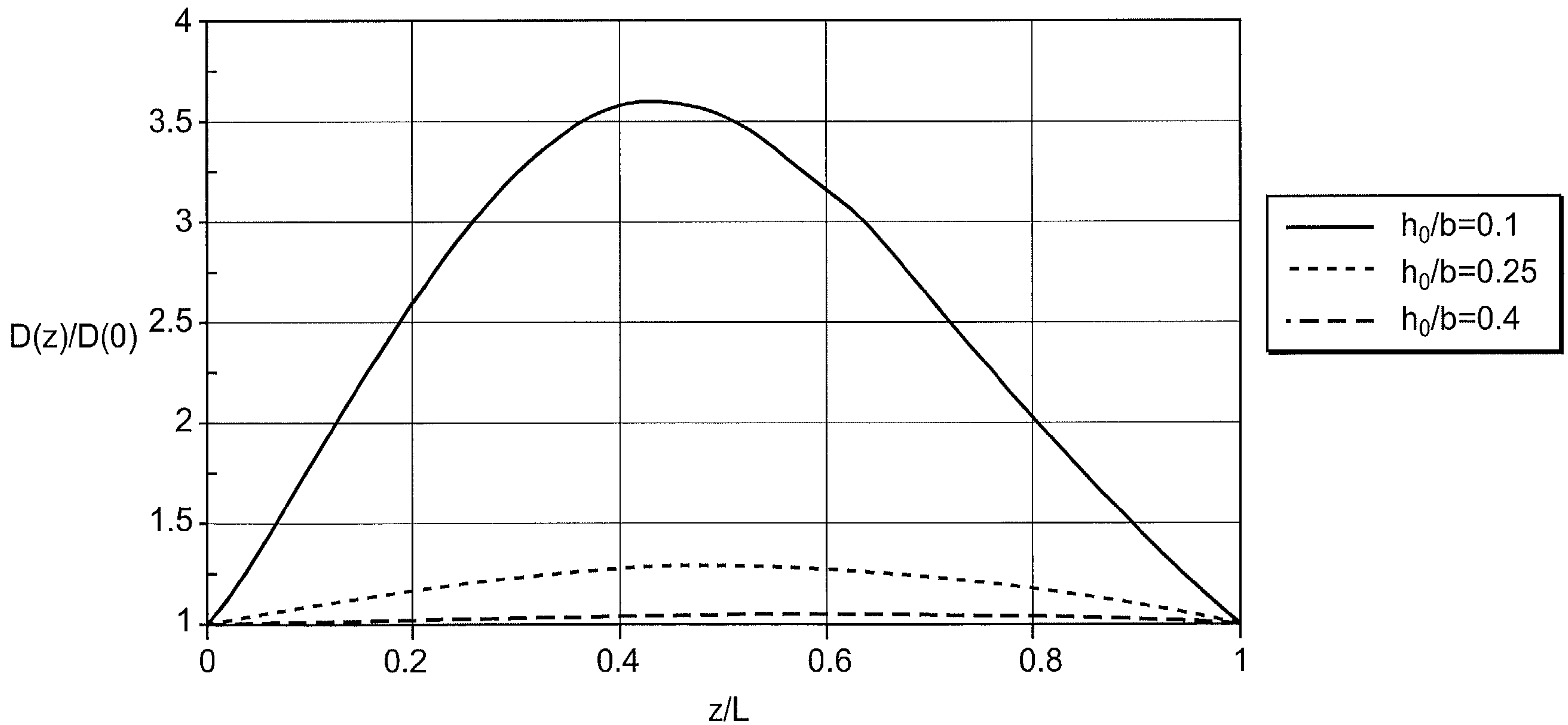


SCHEMATIC FOR ENERGY BALANCE ON AN INFINITESIMAL GUIDE SECTION

FIG. 4

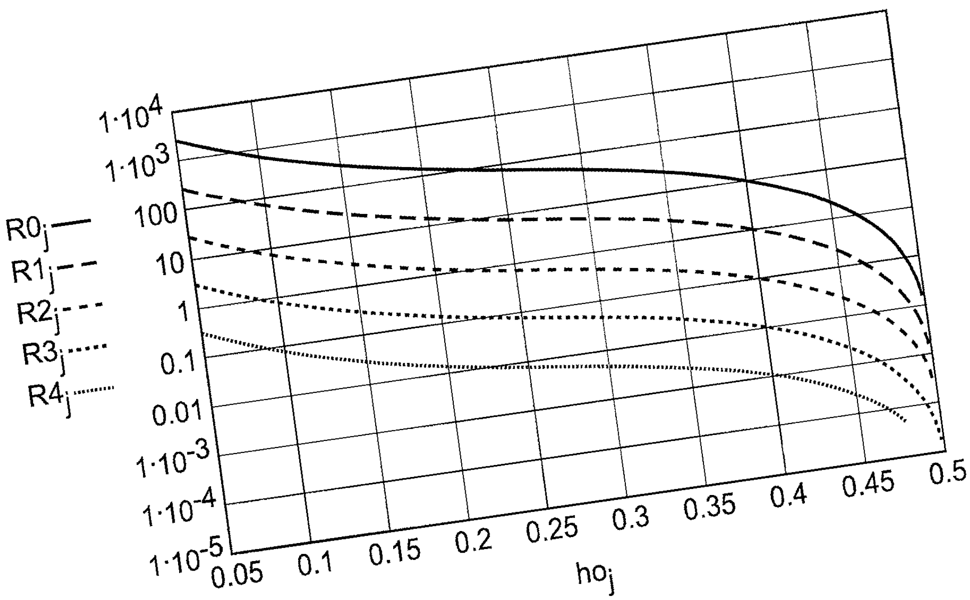
EFFECT OF USING A LINEAR SLOT PROFILE

NORMALIZED LOCAL DISSIPATION: LINEAR SLOT
WITH SAME DISSIPATION AT BOTH ENDS



LINEAR SLOT DISSIPATION PROFILE AS A FUNCTION OF STARTING SLOT HEIGHT

FIG. 5



PLOTS OF THE RANGE OF CURVED-SLOT-COMPENSATED WAVEGUIDE AS A FUNCTION OF h_o/b, THE RATIO OF THE STARTING SLOT HEIGHT TO THE GUIDE BREADTH. CURVES ARE DRAWN FOR DIFFERENT VALUES OF $\varepsilon r''t$ IN METERS. THE VALUES OF $\varepsilon r''t$ PLOTTED ARE LISTED BELOW. THE CURVES DROP TO LOWER VALUES AS $\varepsilon r''t$ INCREASES.

$b=0.072$ GUIDE BREADTH IN m

$f=2.45\cdot 10^9$ FREQUENCY IN Hz

$\sin(\pi\cdot \min)^2=0.024$

$$\varepsilon rt=\begin{bmatrix}5\cdot 10^{-6}\\5\cdot 10^{-5}\\5\cdot 10^{-4}\\5\cdot 10^{-3}\\0.05\end{bmatrix}$$

FIG. 6

THE SHAPE OF A SLOT CURVE FOR A GIVEN
$\varepsilon r''t$ AND h_o/b

$\varepsilon rt := 10^{-4}$ WEB IMAGINARY DIELECTRIC CONSTANT TIMES THICKNESS IN METERS

$N := 1000$ NUMBER OF DATA POINTS IN A SLOT CURVE PLOT

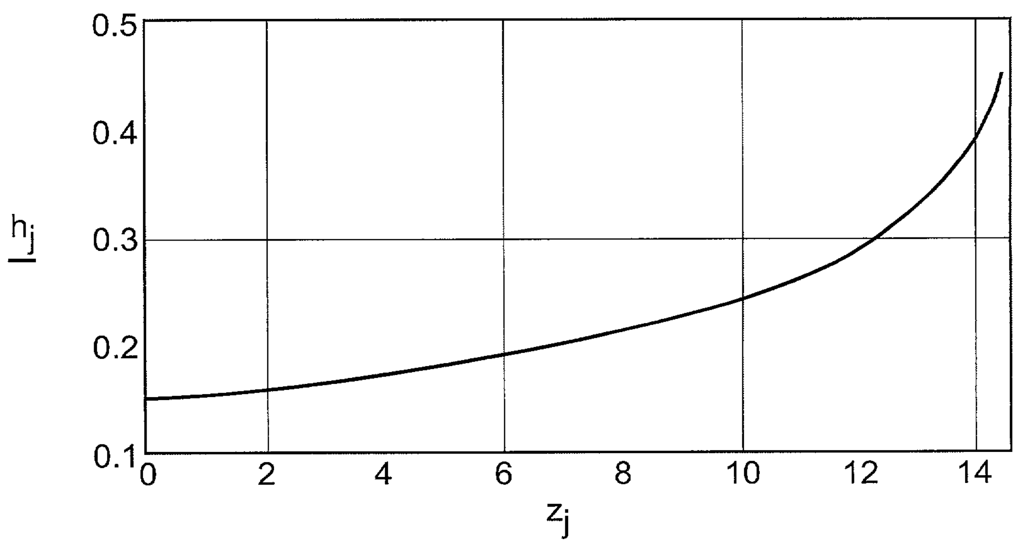
$j := 0..N-1$ ITERATION PARAMETER FOR RANGE PLOTS

$homin := .15$ STARTING RATIO OF h/b

$$zmax := \frac{b\cdot\left(\frac{1}{\sin(\pi\cdot homin)^2}-1\right)}{2\cdot\omega\cdot Z\cdot\varepsilon_o\cdot\varepsilon rt}$$ MAXIMUM VALUE OF COMPENSATED z

$$z_j := .99\cdot zmax\cdot\frac{j}{N-1}$$ VALUES FOR SLOT HEIGHT PLOTS

$$h_j := \left(\frac{t}{\pi}\right)\cdot asin\left[\left(\frac{1}{\sin(\pi\cdot homin)^2}-2\cdot\omega\cdot Z\cdot\varepsilon_o\cdot\frac{\varepsilon rt}{b}\cdot z_j\right)^{\frac{-1}{2}}\right]$$ SLOT HEIGHT VALUES NORMALIZED TO b AS A FUNCTION OF z



HEIGHT OF THE SLOT DIVIDED BY THE GUIDE BREADTH AS A FUNCTION OF GUIDE LENGTH IN METERS

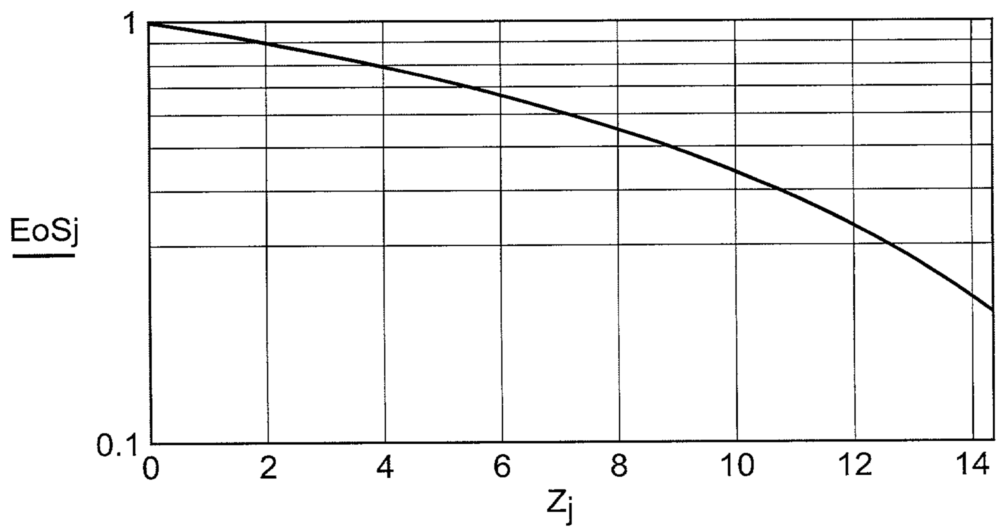
$zmax = 14.443$ RANGE OF COMPENSATION IN METERS

FIG. 7

RATIO OF THE E FIELD INTENSITY AT THE GUIDE CENTER TO ITS INITIAL VALUE AS A FUNCTION OF z FOR THE SAME PARAMETERS AS IN THE SLOT SHAPE CURVE.

$$EoS_j := \left(1-2\cdot\omega\cdot Z\cdot\varepsilon_o\cdot\frac{\varepsilon rt}{b}\cdot z_j\cdot\sin(\pi\cdot homin)^2\right)$$

THE RATIO OF Eo SQUARED TO Eoo TO SQUARED AS A FUNCTION OF Z.



PLOT OF THE RELATIVE CENTER GUIDE FIELD INTENSITY VERSUS GUIDE LENGTH FOR AN IMS OPTIMUM COMPENSATED SLOTTED WAVEGUIDE. THE z AXIS IS IN METERS AND THE y AXIS IS INTENSITY RATIOED TO ITS VALUE AT z=0.

$\varepsilon rt=1\cdot10^{-4}$	WEB IMAGINARY DIELECTRIC CONSTANT TIMES THICKNESS (m)
homin=0.15	INITIAL h/b
zmax=14.443	RANGE OF COMPENSATION IN METERS

FIG. 8

$M := 4$ NUMBER OF WEB RUNS

$R = 1.5$ MAXIMUM RATIO OF εrt OPERATION TO εrt DESIGNED

$m = 0..M-1$ ITERATION PARAMETER

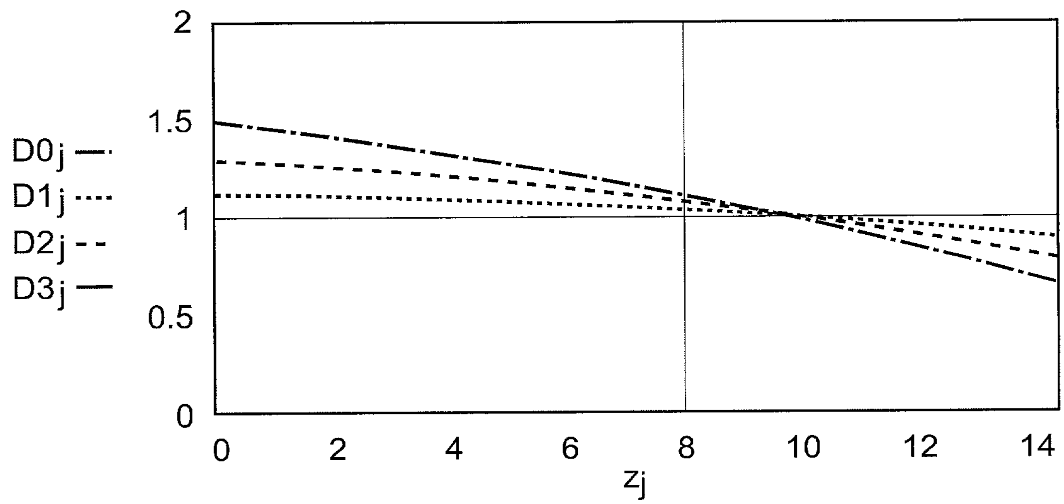
$r_m := R^{\frac{m}{M-1}}$ THE VALUES OF THE RATIO OF THE ACTUAL εrt. TO THE DESIGNED εrt.

$$D0_j := r_0 \cdot \left(1 - 2 \cdot \omega \cdot Z \cdot \varepsilon_o \cdot \frac{\varepsilon rt}{b} \cdot z_j \cdot \sin(\pi \cdot homin)^2\right)^{r_0 - 1}$$

$$D1_j := r_1 \cdot \left(1 - 2 \cdot \omega \cdot Z \cdot \varepsilon_o \cdot \frac{\varepsilon rt}{b} \cdot z_j \cdot \sin(\pi \cdot homin)^2\right)^{r_1 - 1}$$

$$D2_j := r_2 \cdot \left(1 - 2 \cdot \omega \cdot Z \cdot \varepsilon_o \cdot \frac{\varepsilon rt}{b} \cdot z_j \cdot \sin(\pi \cdot homin)^2\right)^{r_2 - 1}$$

$$D3_j := r_3 \cdot \left(1 - 2 \cdot \omega \cdot Z \cdot \varepsilon_o \cdot \frac{\varepsilon rt}{b} \cdot z_j \cdot \sin(\pi \cdot homin)^2\right)^{r_3 - 1}$$



PLOTS OF THE WEB HEAT DISSIPATION RELATIVE TO THE HEAT DISSIPATION AT z=0 IN THE DESIGNED WAVEGUIDE AS A FUNCTION OF WAVEGUIDE LENGTH IN METERS. DIFFERENT CURVES HAVE DIFFERENT RATIOS OF εrt OPERATING TO εrt DESIGNED. THE ACTUAL RATIOS ARE LISTED BELOW AS r.

$\varepsilon rt = 1 \cdot 10^{-4}$ DESIGNED WEB IMAGINARY DIELECTRIC CONSTANT TIMES THICKNESS (m)

$zmax = 14.443$ RANGE OF COMPENSATION IN METERS

$homin = 0.15$ INITIAL h/b

$$r = \begin{bmatrix} 1 \\ 1.145 \\ 1.31 \\ 1.5 \end{bmatrix}$$

FIG. 9

TWO SERPENTINE MICROWAVE APPLICATOR CONFIGURATIONS:
(a) SHORT AT TERMINATION END; (b) DUMMY LOAD AT TERMINATION END.

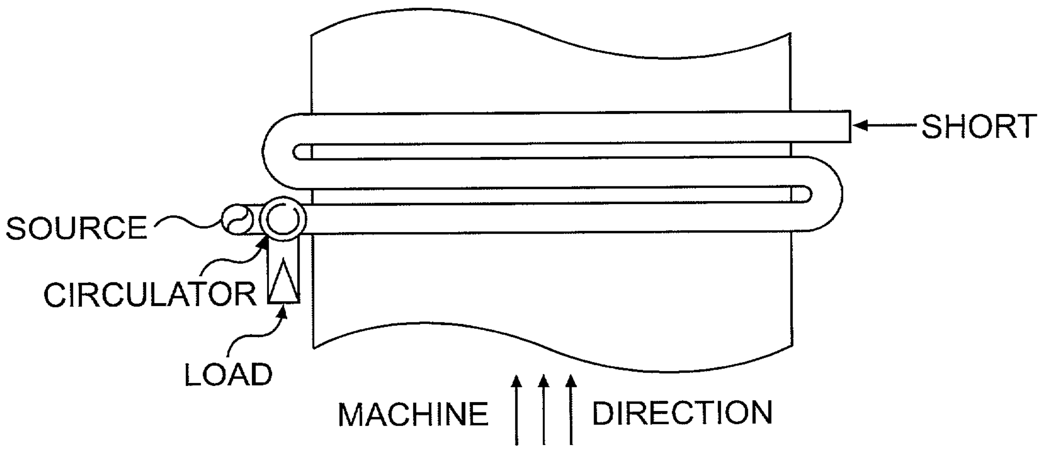


FIG. 10(a)

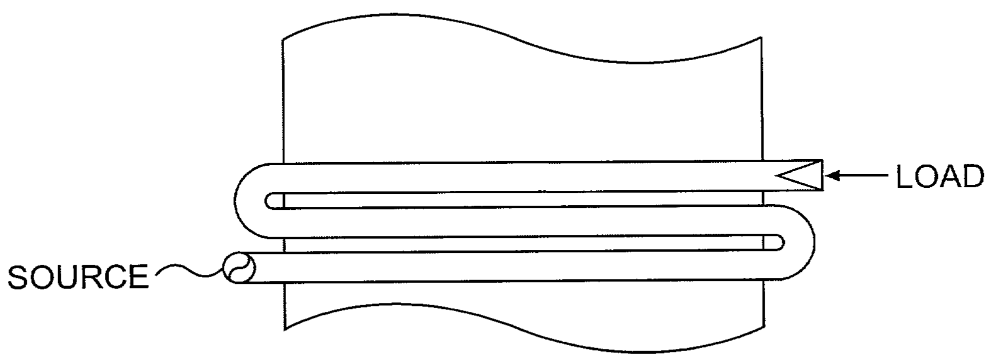


FIG. 10(b)

DEFINITION OF SLOT (AND PAPER) LOCATION WITHIN THE WAVEGUIDE.

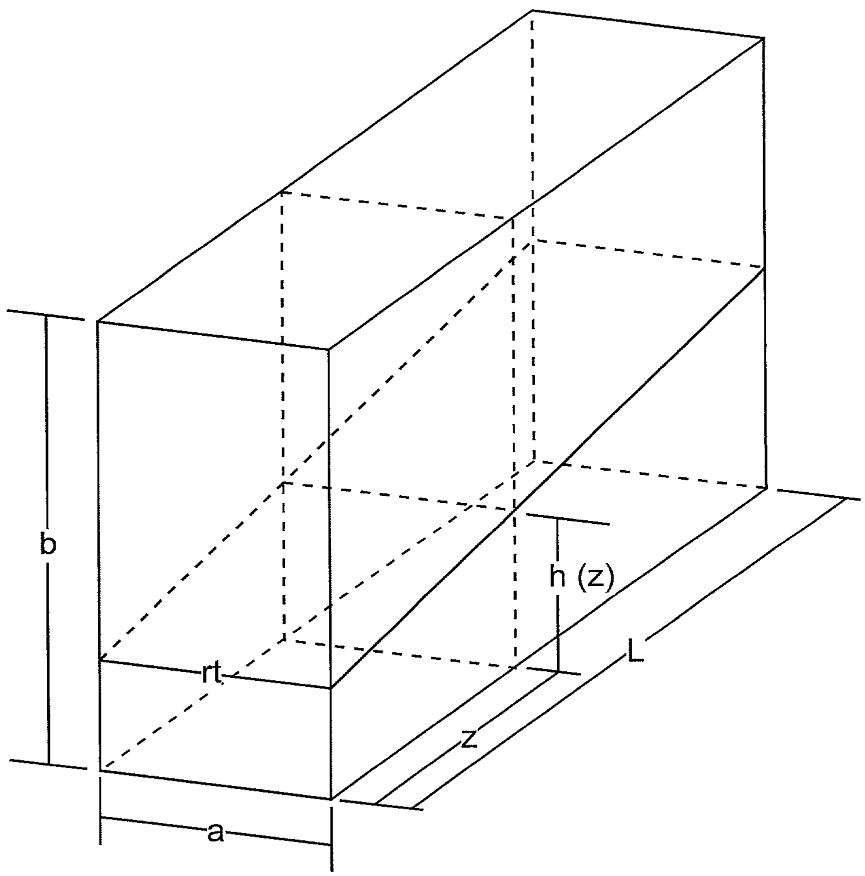
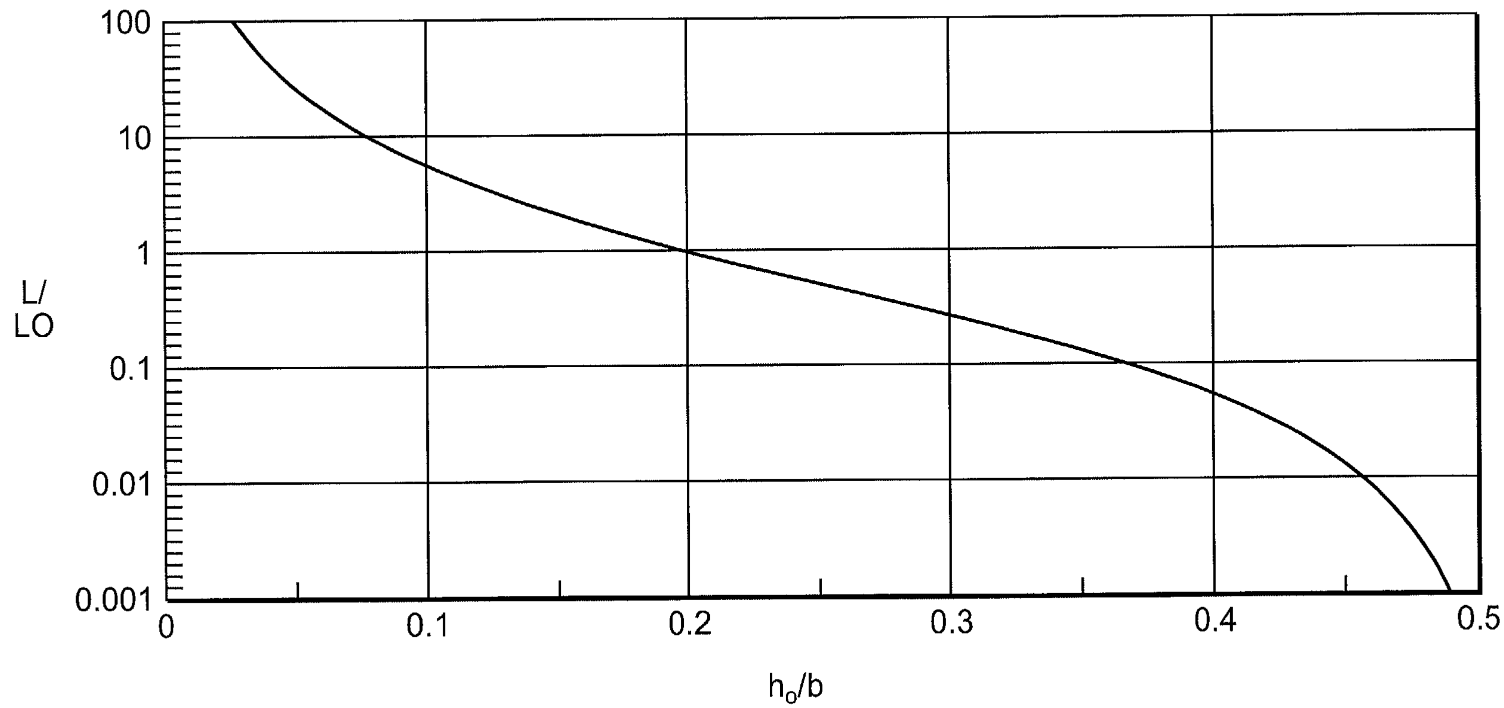
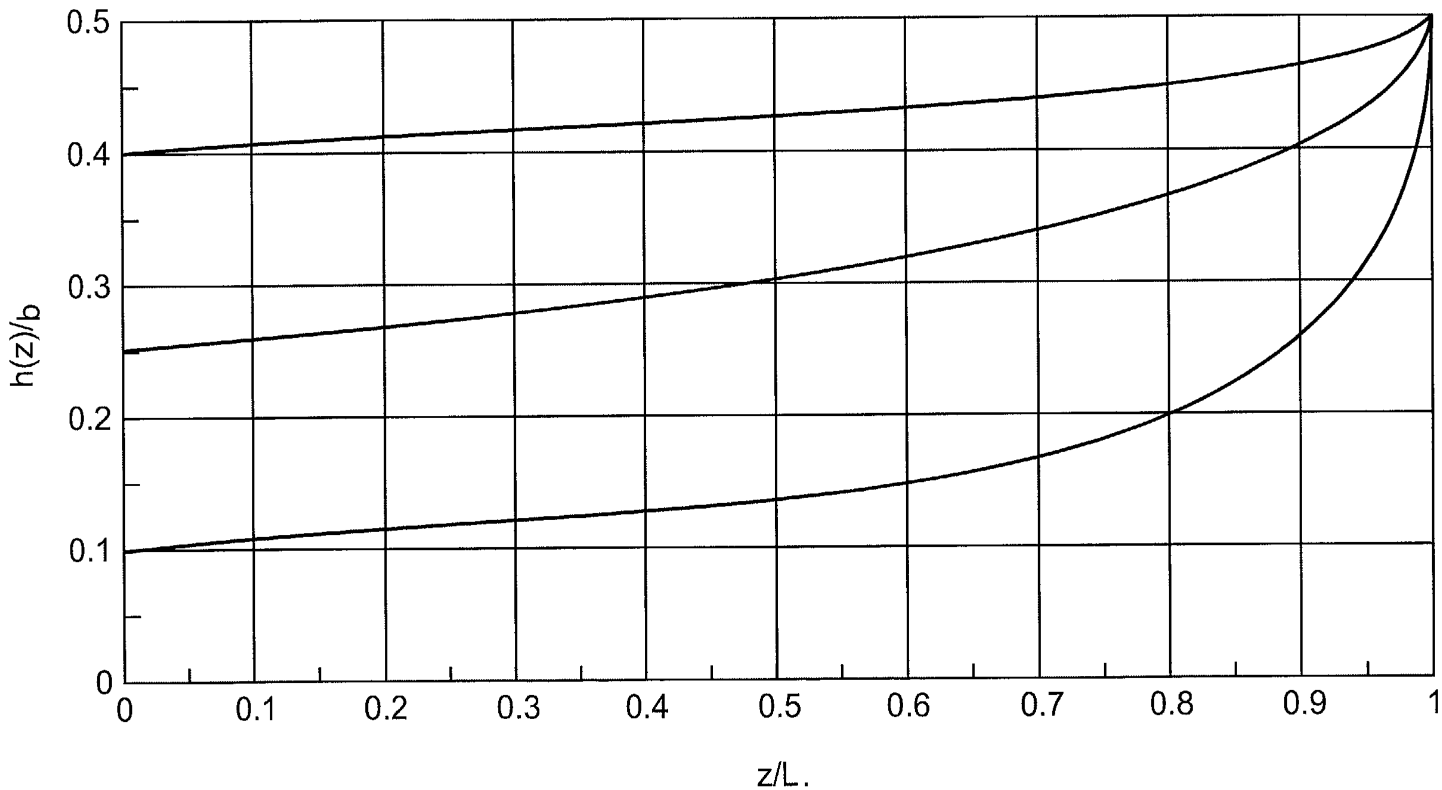


FIG. 11



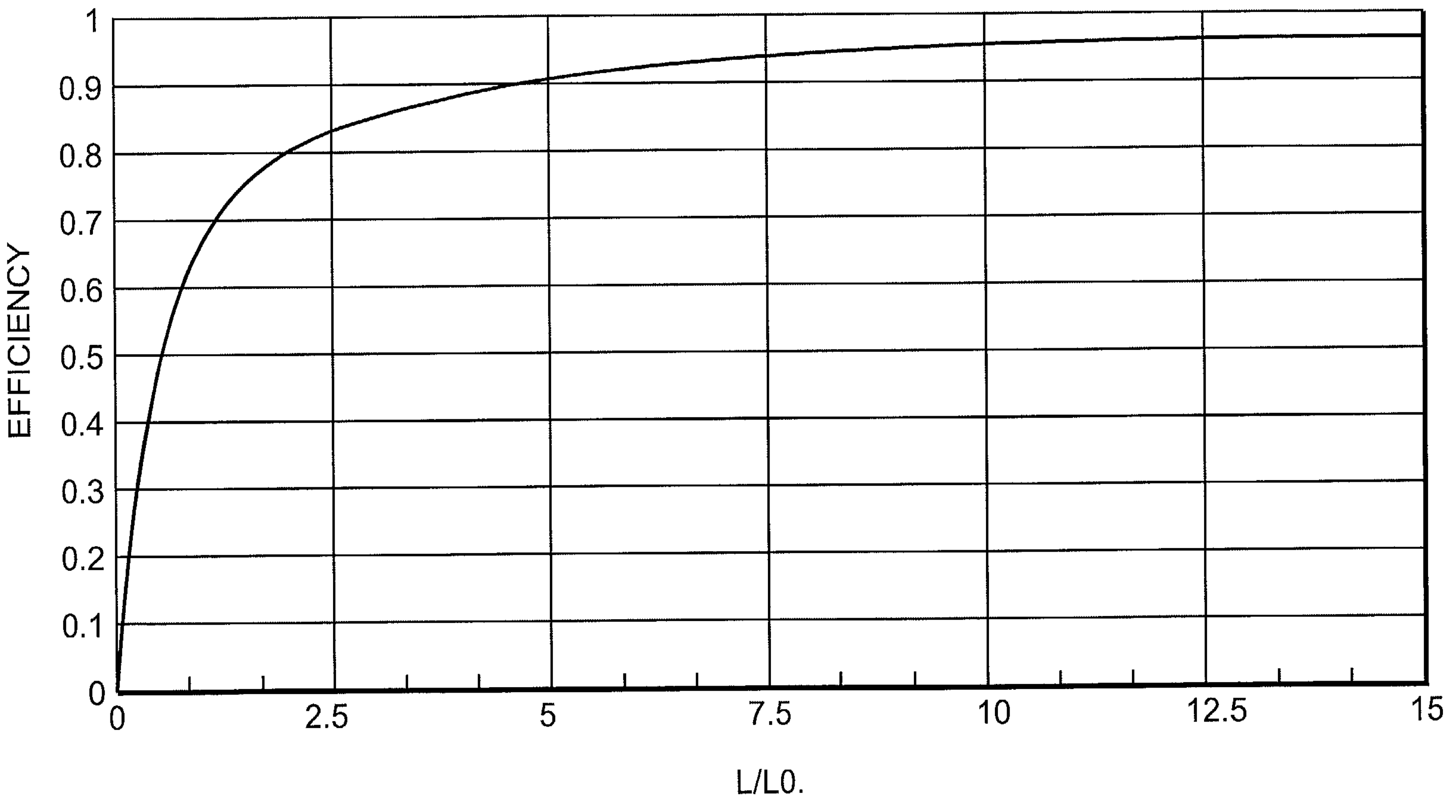
IDEAL DIMENSIONLESS LENGTH VS. INITIAL SLOT HEIGHT

FIG. 12



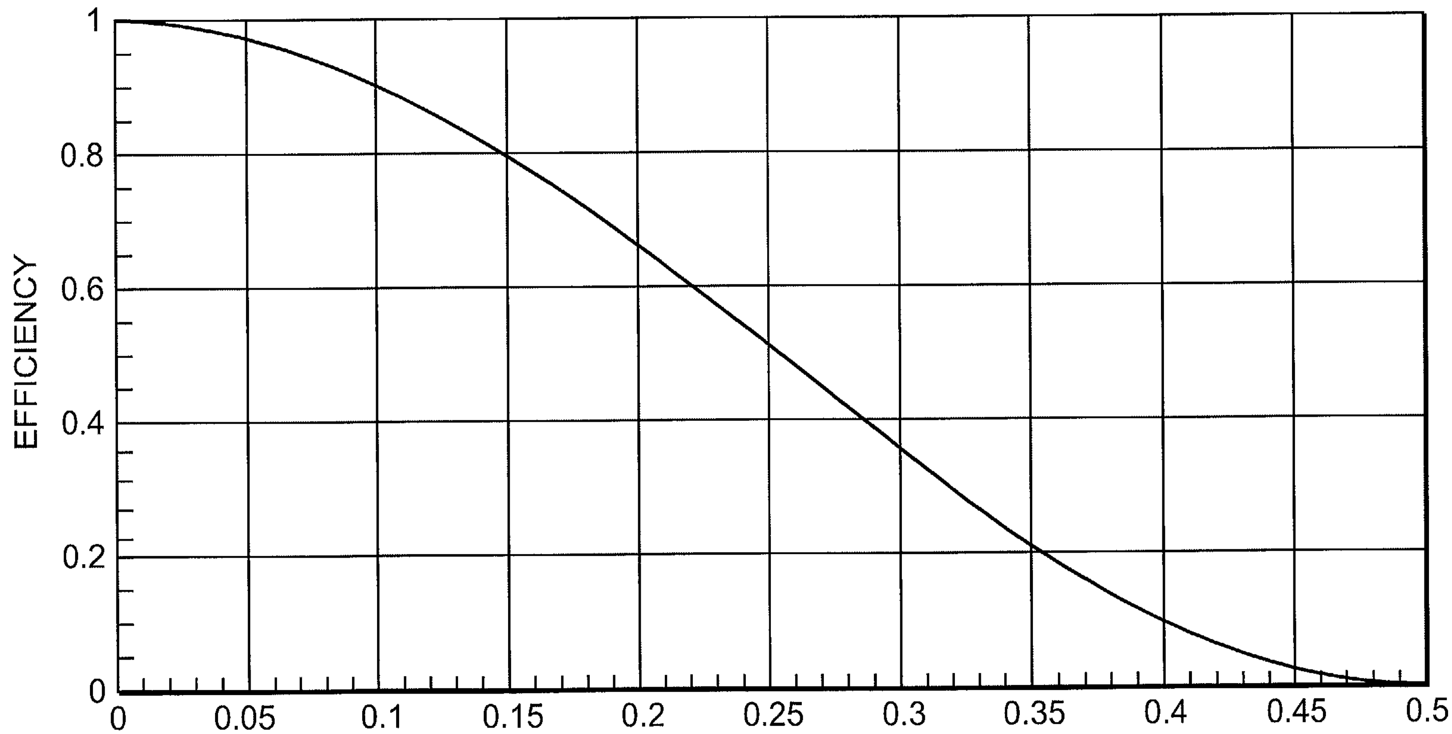
IDEAL SLOT SHAPES fo h_o/b = 0.1,0.25,0.4.

FIG. 13



EFFICIENCY VS. IDEAL DIMENSIONLESS LENGTH

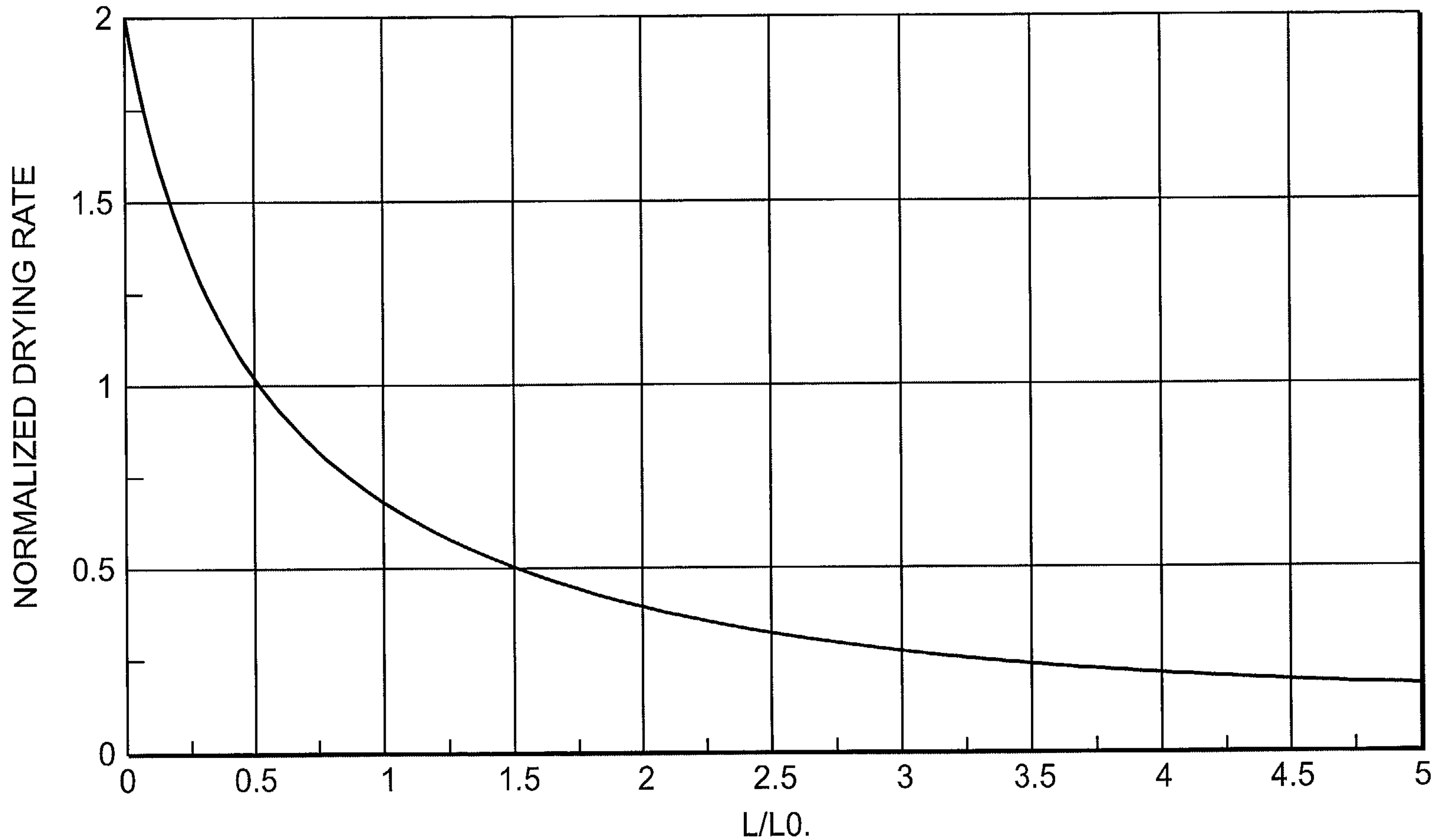
FIG. 14



$h_o/b.$

EFFICIENCY (AT IDEAL LENGTH) VS. INITIAL HEIGHT

FIG. 15



NORMALIZED DRYING RATE FOR IDEAL LENGTH.

FIG. 16

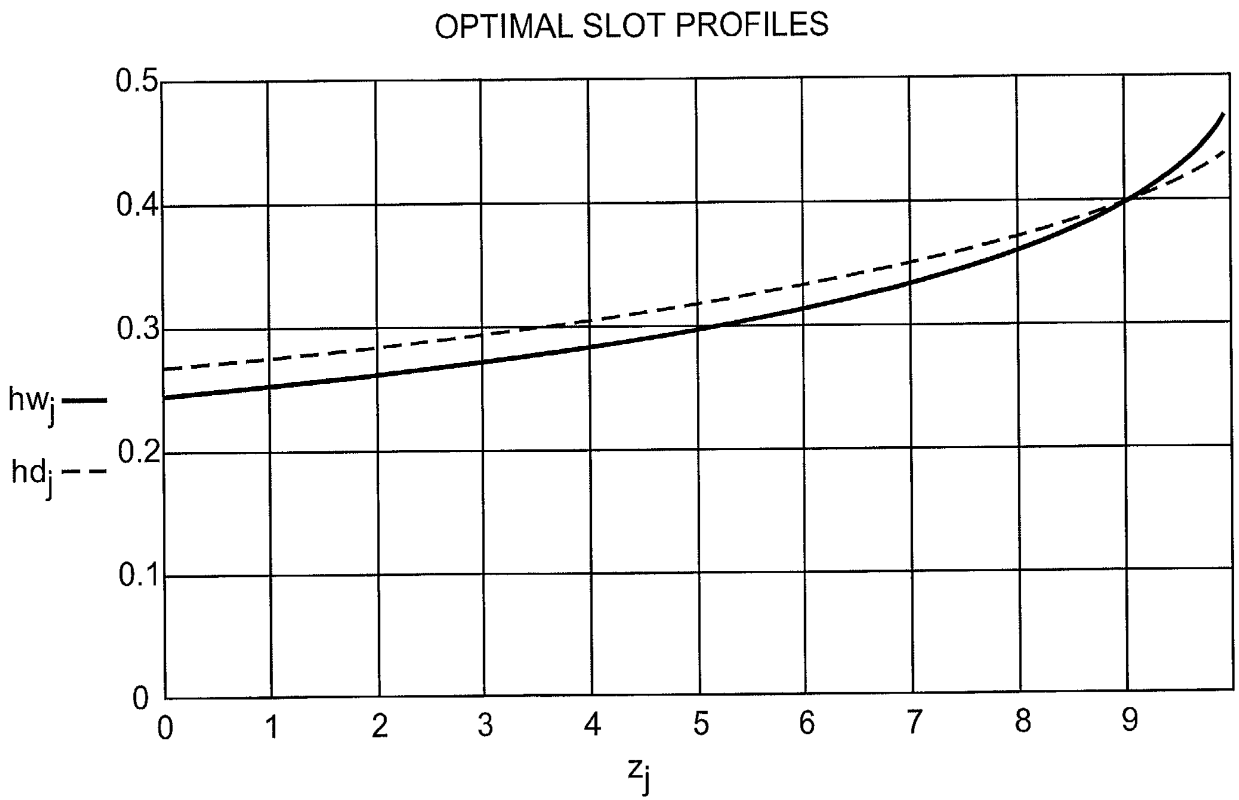
THE SLOT HEIGHT PROFILE, h(z), WHICH GIVES UNIFORM DRYING DEPENDS ON THE PAPER BASIS WEIGHT AND ITS MOISTURE CONTENT, ε_r"t.

THE OPTIMAL SLOT PROFILE IS

$$h(z) = (b/\pi)\sin^{-1}[(1/\sin^2(\pi h_0/b)-2Z\omega\varepsilon_0\varepsilon_r''tz/b)^{-1/2}]$$

WHERE h_0 REPRESENTS THE SLOT HEIGHT AT THE SOURCE SIDE OF THE WEB AND z IS THE DISTANCE ALONG THE WAVEGUIDE (CD).

FIG. 17



PLOTS OF THE OPTIMAL SLOT HEIGHT DIVIDED BY THE WAVEGUIDE HEIGHT AS A FUNCTION OF DISTANCE IN METERS FROM A MICROWAVE SOURCE AT 2.45 GHz IN AN S-BAND WAVEGUIDE. THE SOLID LINE IS DESIGNED FOR A 200 g/m^2 BOARD AT 10% MOISTURE, WHEREAS THE DOTTED LINE IS FOR 7% MOISTURE.

FIG. 18

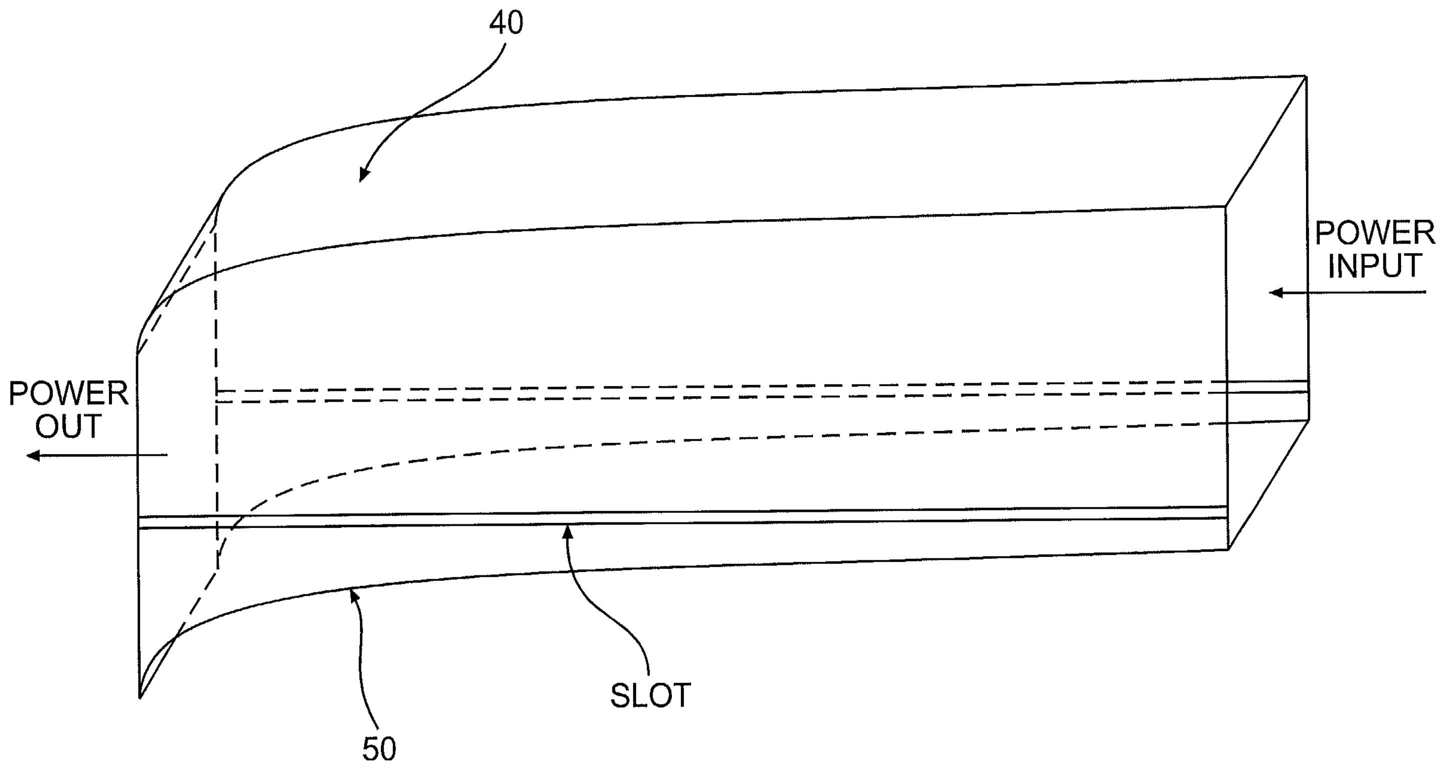
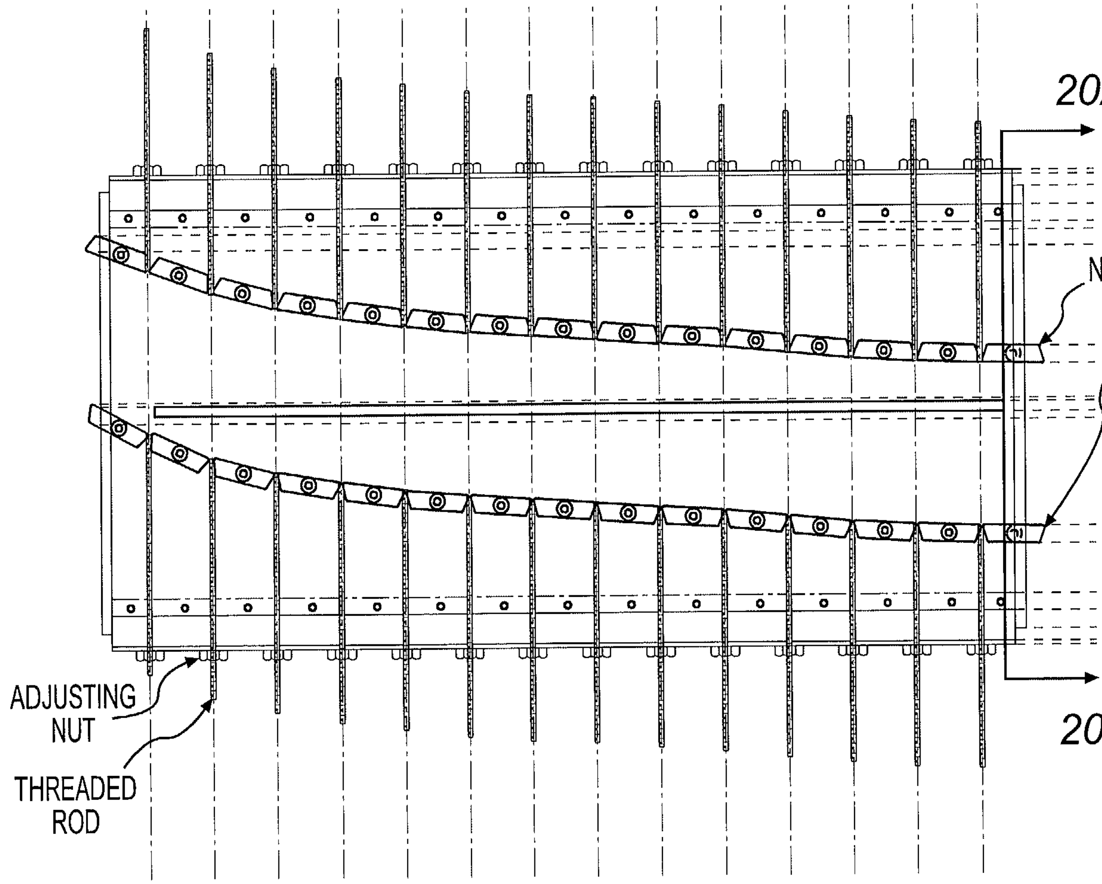


FIG. 19



MANUALLY ADJUSTED VARIABLE WAVEGUIDE

FIG. 20B

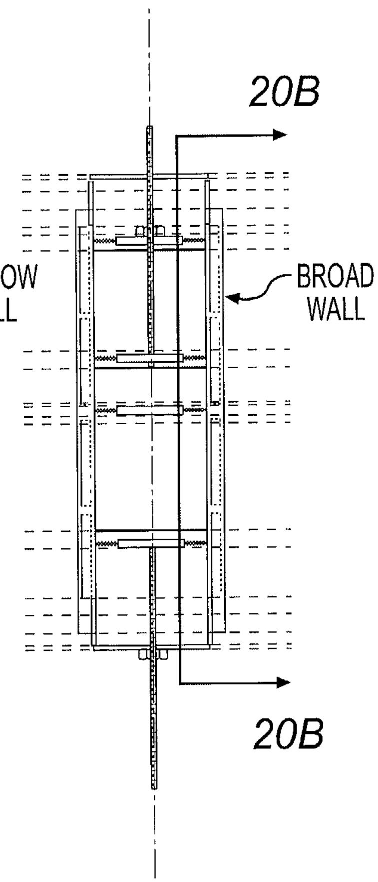
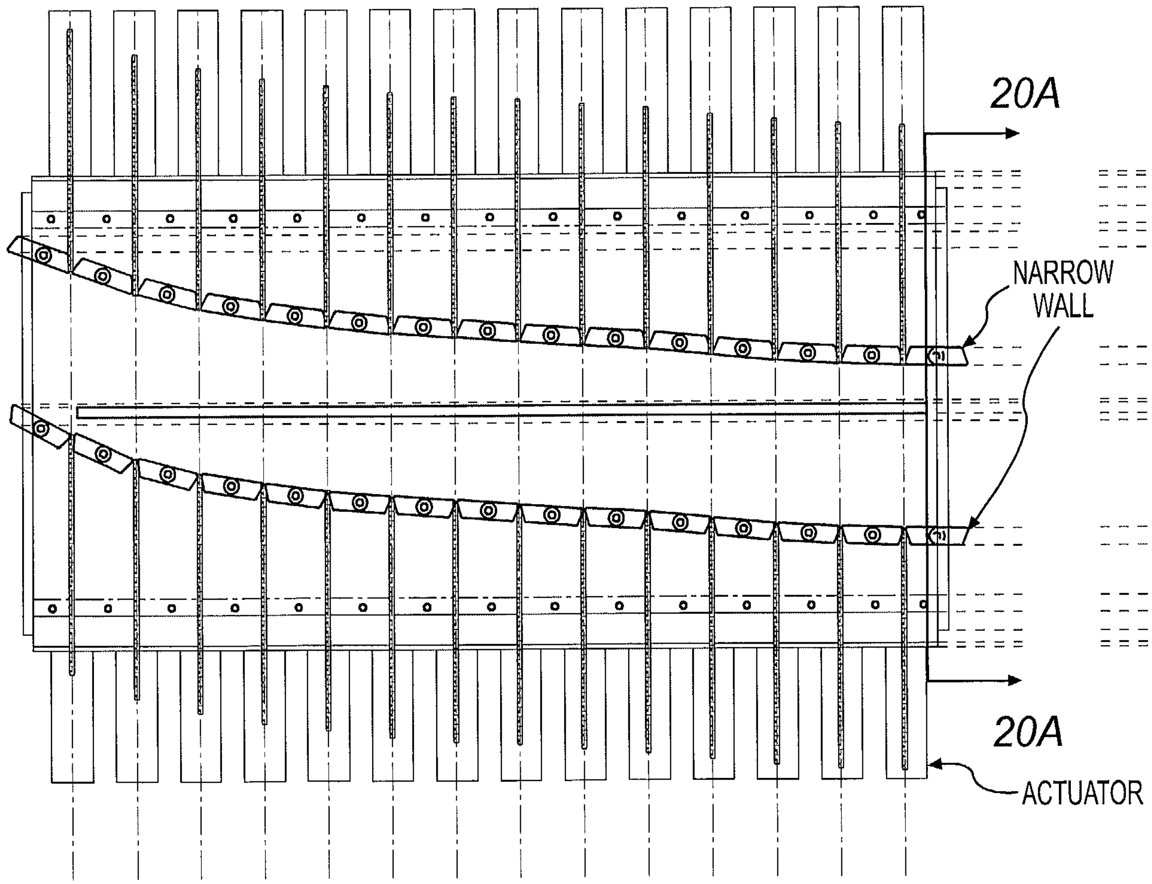


FIG. 20A



AUTOMATICALLY ADJUSTED VARIABLE WAVEGUIDE

FIG. 21B

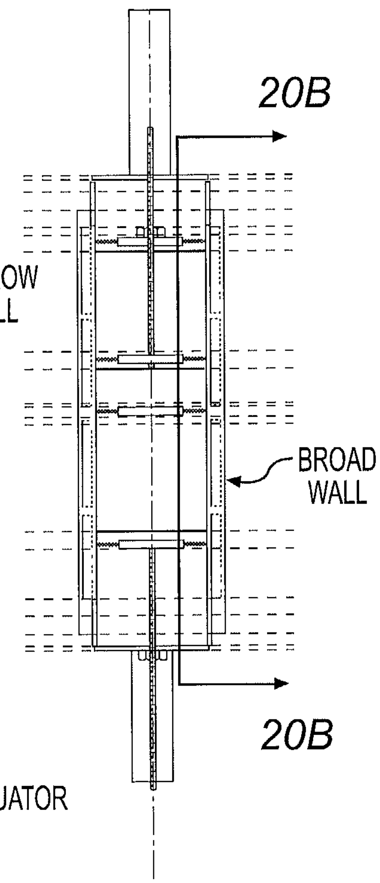


FIG. 21A